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D. Remarks

Objections to Claims.

Claim 22 has been amended as suggested by the Examiner.

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A. Rejection of Claims 1, 3, 5-7, 9, 11, 21-23 and 25 Under 35 U.S.C. §102(e) or alternatively under 35 U.S.C. §103(a) based on U.S. Patent No. 6,242,323 (*Ishitsuka et al.*).

The rejection of claims 1, 3, 5 and 21 will first be addressed.

10 The invention of claim 1 is directed to a semiconductor device that includes a trench element separation region including a trench formed in a surface of a semiconductor substrate. The trench element separation region isolates separate semiconductor elements. An oxide film is formed on inner walls of the trench. A trench filling insulating material fills the trench and has edges above the inner walls of the trench. Inner wall edges in a top section of the trench and edges of the trench filling insulating material are formed to be essentially located on the same
15 plane when viewed in cross section.

Applicant's claim 1 invention also includes the following limitation:

20 “the edges of the trench filling material are defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical performed for the trench filling process”.

Applicant submits the following as evidence that (1) claim 1 presents a structure that is substantially different from the cited art and (2) such structural differences are patentably distinct.

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1. The Structure of Claim 1 is Different from that of *Ishitsuka et al.*

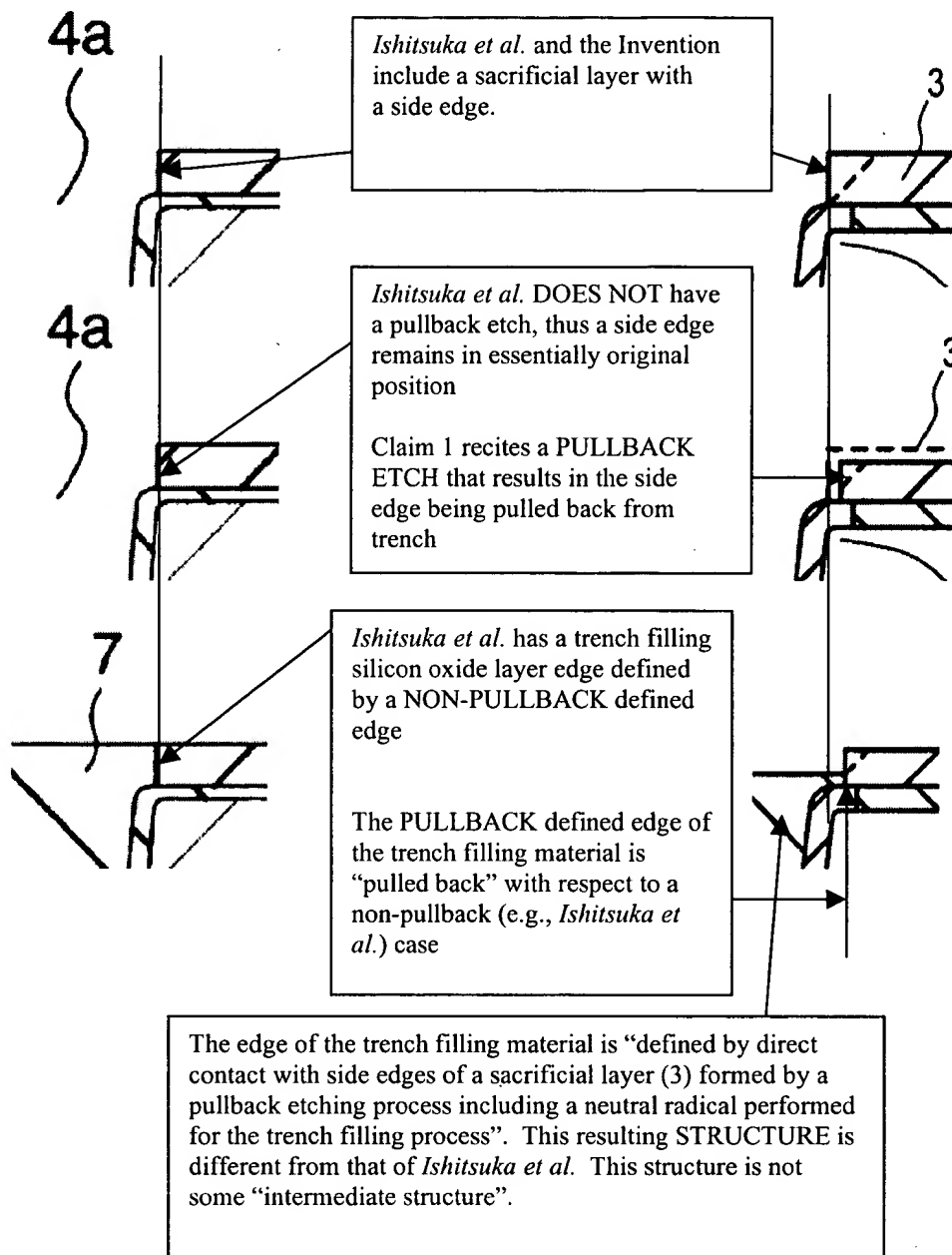
The limitations of claim 1 present structural differences when compared with the cited reference. These differences were previously presented (see the Response to Office Action, dated June 10, 2004, Page 12), and resubmitted:

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Ishitsuka et al.
(FIGS. 16 and 19)

Claim 1 (as supported by example
of FIGS. 1(a) to 1(d) in the Specification)



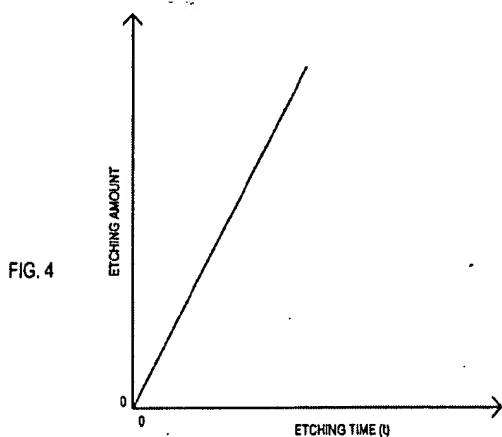
The above is believed to be clear evidence that structural differences exist between *Ishitsuka et al.* and the claim 1.

2. Claim 1 is Patentably Distinct from *Ishitsuka et al.*

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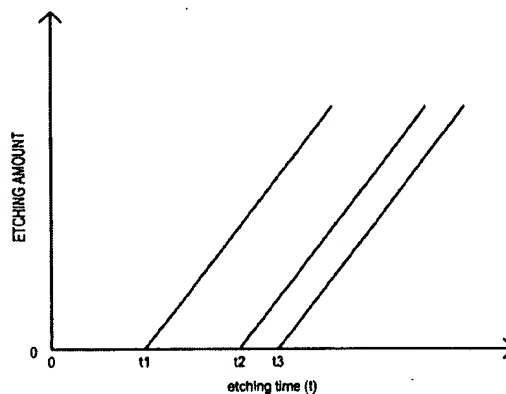
The differences achieved by utilizing Applicant's novel neutral radical pullback etch defined edge, are believed to be clearly patentable. A trench filling material with an edge according to claim 1 can (1) be more precisely positioned than conventional approaches (such as *Ishitsuka et al.*), and (2) produce devices with better (more uniform) threshold voltages.

Applicant has demonstrated above that *Ishitsuka et al.* does not include a trench material edge defined by any sort of etchback, let alone one with a neutral radical. Thus, an edge formed by *Ishitsuka et al.* has more variation. This structural difference of edge position was previously documented by Applicant with reference to FIGS. 4 and 5 of the Specification. This is repeated below:



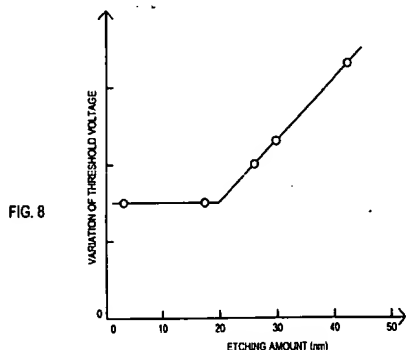
An edge like that of claim 1 (defined by neutral radical pullback etching) is more accurate, as there is a linear relationship between position (set by etch amount) and etch time.

FIG. 5



An edge like that of *Ishitsuka et al.* (formed without neutral radical pullback etching) has more position variation as there is a linear relationship between position and etch time.

The improved positioning of a trench material edge produces transistors with less variation in threshold voltage. This advantage was also previously documented by Applicant with reference to FIG. 8 of the Specification, which shows measurements from one manufacturing lot:



Without precise placement of edge, transistor threshold voltages can have higher variation.

Thus, not only is Applicant's resulting structure difference, the differences has clearly documented effects.

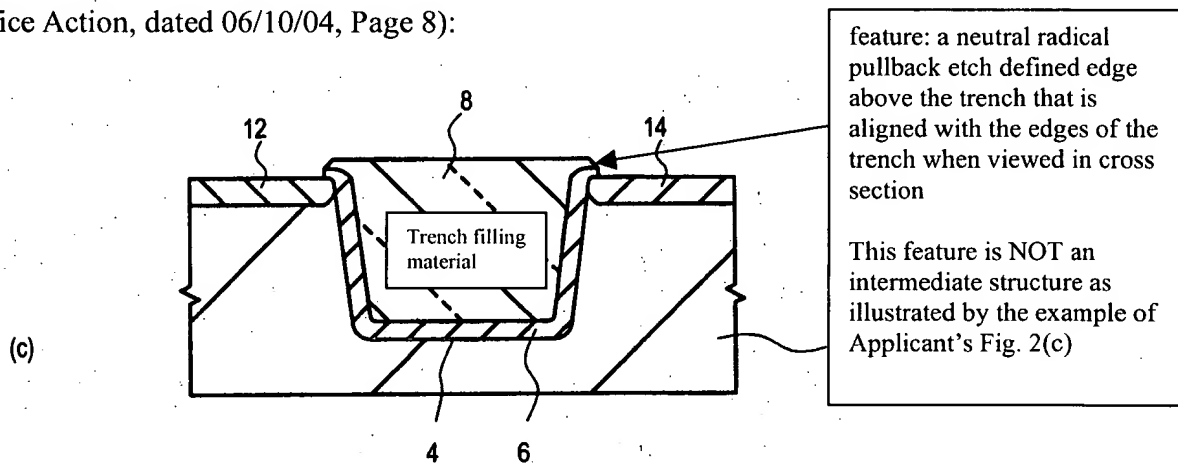
Applicant acknowledges the basis of the rejection, and provides the following comments and rebuttal.

3. Structural Differences of Claim 1 are Not an Intermediate Structure.

Despite Applicant's previous showing, the rejection has been maintained based on the following reasoning.

[T]he claim limitation reciting the edges... defined by... side edges of a sacrificial layer formed by a pull back etching process including a neutral radical... recite intermediate features in intermediate structures Figures 1(c) – 1(d) of the application that no longer exist in the final structure (see Figure 2(c)). (Final Office Action, dated 09/01/04, Page 4, Lines 2-7).

This reasoning is incorrect. As emphasized above, the above claim 1 limitation is directed to the edges of the trench filling material, not a sacrificial layer. Such a feature exists in the final structure (e.g., FIG. 2(c)). This was noted in Applicant's previous Response (See Response to Office Action, dated 06/10/04, Page 8):



Thus, the rejection's argument that the claim limitations are not present in final structure is believed to be incorrect. Accordingly, such limitations must be given consideration when determining patentability of the claim.

The rejection argument continues as follows:

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As far as the device claims are concerned, the final structure as claimed “gleaned” from the process steps is not patentably distinguished over the structure of the prior art reference. (Final Office Action, dated 09/01/04, Page 4, Lines 7-10).

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Applicant believes the above showing demonstrates features that are patentably different from the cited reference. There is no need to “glean” differences between the invention and the prior art reference, as the illustration on Page 9 of this Response explicitly shows these differences.

10 4. Claim 1 Not Identical or only Slightly Different From *Ishitsuka et al.*

Finally, the rejection has restated the well-established case law rationale for allowing 102/103 rejections in the case of certain types of product-by-process claims:

15 Therefore, when the prior art discloses a product which reasonably appears to be identical with or slightly different than the product claimed in product-by-process claim, a rejection based on sections 102 or 103 is fair. The Patent Office is not equipped to manufacture products by a myriad of processes put before it and then obtain prior art product and make physical comparisons therewith. (Final Office Action, dated 09/01/04, Page 4, Lines 7-10, citing In re Brown, 173 USPQ 685
20 (C.C.P.A. 1972), emphasis added).

Applicant does not believe the above case is applicable to the facts at hand. First, the invention of claim 1 cannot reasonably be considered identical to that the cited reference. Second, the above factual presentation shows that claim 1 and *Ishitsuka et al.* are more than slightly different.
25 Finally, Applicant’s Specification provides a clear demonstration of the steps at issue, and resulting effects, eliminating any confusion about the manufacturing steps, and the effects of such steps on the end product. That is, Applicant’s have clearly met any additional showing required by a shift in the burden of proof.

30 The rejection of claims 7, 9 and 11 will now be addressed.

Claim 7 is directed to a semiconductor device that includes a trench formed in a surface

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of a semiconductor substrate. The trench element separation region isolating a first doped channel layer of a first insulated gate field effect transistor (IGFET) from a second doped channel layer of a second IGFET. Also included are an oxide film formed on inner walls of the trench and a trench filling insulating material filling the trench.

5 The trench filling insulating material has edges above the inner walls of the trench defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical performed before filling the trench. The inner wall edges in a top section of the trench and the edges of the trench filling insulating material are formed so as to be essentially located on the same plane when viewed in cross section

10 To address this ground for rejection, Applicant incorporates by reference the same general arguments set forth above for claim 1. Namely, that the reference does not show or suggest the structural limitation of a side edge “defined by direct contact with side edges of a sacrificial layer formed by a pullback etching process including a neutral radical”.

15 The new rejection of claim 22-23 and 25 will now be addressed.

Applicant first addresses this ground for rejection by incorporating by reference the comments set forth above for claim 1. In particular, amended claim 22 recites a trench filling insulating material with a “neutral radical pullback defined trench edge”. This physical feature is not shown in the reference, and presents a patentable difference between the claim 22 and
20 *Ishitsuka et al.*

Second, Applicant has amended claim 22 to include the limitations of dependent claim 24. Claim 24 was not rejected based in *Ishitsuka et al.* Accordingly, amended claim 22 includes limitations not demonstrated to be shown in or suggested by the cited reference.

25 B. Rejection of Claims 7, 9, 10 and 22-24 Under 35 U.S.C. §102(e) or §103(a) based on Bhakta et al. (U.S. Patent No. 6,258,697).

The rejection of claims 7, 9 and 10 will first be addressed.

As in the case of the reference *Ishitsuka et al.*, Applicant believes sufficient evidence has been presented to show that the resulting claim 7 structure is not obvious. These differences will
30 be described and documented below.

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1. The Structure of Claim 7 is Different from that of *Bhakta et al.*

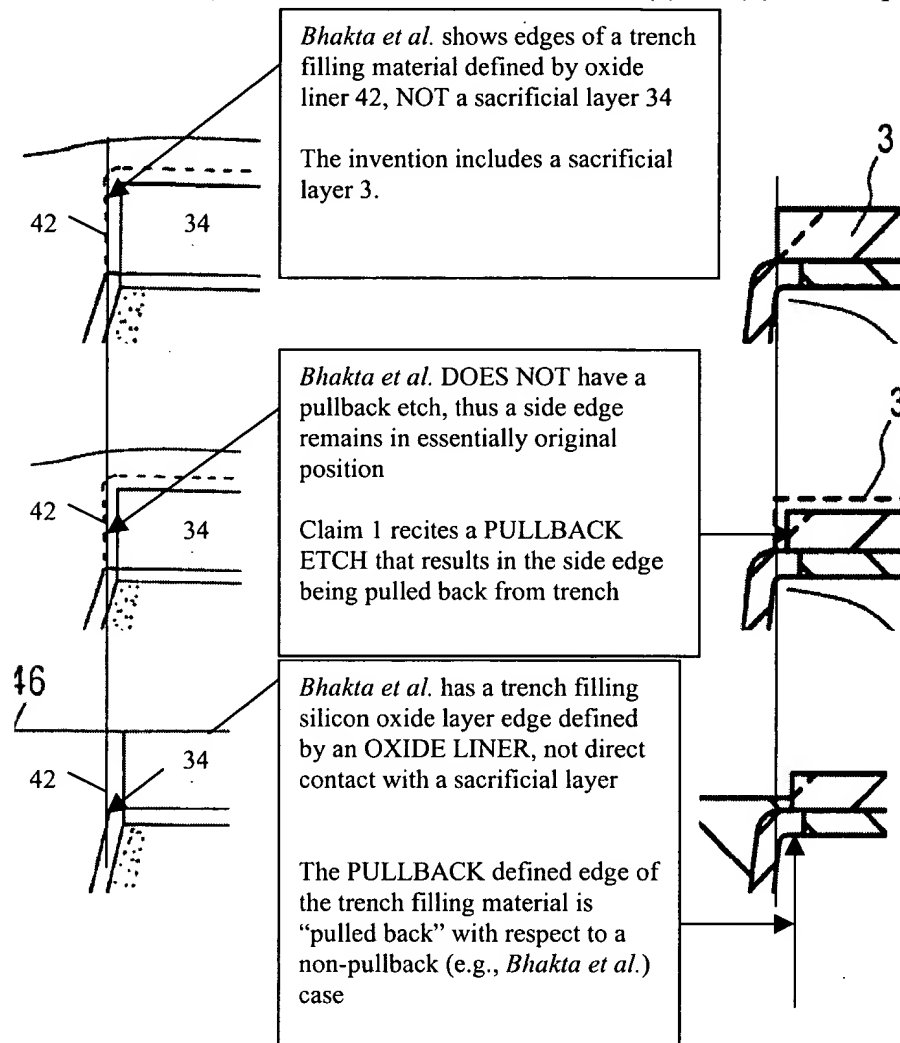
The limitations of claim 7 are compared below with the teachings of *Bhakta et al.* This represents a re-submission of a previously presented data:

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Bhakta et al.
(FIGS. 3D and 3G)

Claim 7 (as supported by example
of FIGS. 1(a) to 1(d) of the Specification)

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The above is believed to clearly show a structural difference between the cited reference and the claimed invention.

2. Claim 7 is Patentably Distinct from *Bhakta et al.*

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Applicant incorporates by reference the same comments set forth above in Section A.2.

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for claim 1 with respect to the patentability of the clear differences between claim 7 and *Bhakta et al.* In summary, the structural differences present patentable differences over the cited reference.

5 3. Structural Differences of Claim 7 are Not an Intermediate Structure.

The rejection of claim 7, like the rejection of claim 1, asserts that certain of Applicant's claim 7 limitations are directed to an intermediate structure.

10 [T]he claim limitation reciting the edges of trench filling insulating material being defined by... in claim 7 recite intermediate features in intermediate structures Figures 1(c) – 1(d) of the application that no longer exist in the final structure (see Figure 2(c)). (Final Office Action, dated 09/01/04, Page 6, Lines 15-20).

To address this point, Applicant's incorporate the same argument set forth in Section A.3. above:

15 “edges of a trench filling insulating material” are clearly present in the “final” structure.

4. Claim 7 Not Identical or only Slightly Different From *Bhakta et al.*

Applicant incorporates herein the same general comments as Section A.4. The rejection's argument that the invention of claim 7 is identical with or only slightly different from the reference *Bhakta et al.* has been rebutted by clear evidence of the differences, and considerable beneficial effects of such differences.

The new rejection of claims 22-24 will now be addressed.

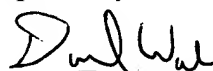
25 To address this ground for rejection, Applicant incorporates by reference herein the same general comments set forth above for claim 7. In particular, the limitation of “a neutral radical pullback etch defined edge” presents a significant, patentable difference with respect to the structure of *Bhakta et al.*

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Claim 22 has been amended. Claim 24 has been cancelled. The present claims 1, 3, 5-7, 9-11, and 21-25 are believed to be in allowable form. It is respectfully requested that the application be forwarded for allowance and issue.

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Respectfully Submitted,

 11/23/04

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